

Lesson II.

Petroleum Generation Processes

I. Active Vocabulary from Lesson II.

deposit [dɪ'pɒzɪt] - n	осадок, отложение; отстой There are rich <i>deposits</i> of gas in the North Sea.
deposit [dɪ'pɒzɪt] - v	отлагаться, осаждаться The Colorado River <i>deposits</i> large amounts of sediment in Lake Powell.
deficient [dɪ'fɪʃənt] - a	недостаточный, лишённый (ч-л) Women who are dieting can become iron <i>deficient</i> .
deficiency [dɪfɪʃənsɪ] - n	недостаток, отсутствие (ч-л) There is <i>deficiency</i> of safe playgrounds for children in big cities.
environment [ɪn'vaɪrəmənt] - n	окружающая среда Some of these chemicals are very damaging to the <i>environment</i> .
essential [ɪ'senʃəl] - a	необходимый, весьма важный Even in small companies, computers are an <i>essential</i> tool.
interface ['ɪntəfeɪs] - n	граница (поверхность) раздела The boundary between phases in a heterogeneous system is an <i>interface</i> .
destroy [dɪs'trɔɪ] - v	уничтожать, разрушать, разлагать A vast amount of the Amazonian rainforest is being <i>destroyed</i> every day.
retain [rɪ'teɪn] - v	удерживать, сдерживать 1) Water <i>retains</i> heat much longer than air. 2) A lot of information can be <i>retained</i> in your computer.
shallow ['ʃæləu] - a	мелкий The river is too <i>shallow</i> for our boat.
cease [si:s] - v	прекращать(ся), переставать The factory has now <i>ceased</i> production and will close next month.
derive (from) [dɪ'raɪv] - v	получать, извлекать; происходить 1) The word "deposit" is <i>derived</i> from Latin. 2) The enzyme is <i>derived</i> from human blood.
complete [kəm'pli:t] - v	заканчивать <i>Complete</i> the sentences using either the simple past or present perfect tense of the verbs.
complete [kəm'pli:t] - a	полный, законченный The police were in <i>complete</i> control of the situation.
relative ['relatɪv] - a	относительный, сравнительный You may think you're poor, but it's all <i>relative</i> (= you are not

relatively [ˈrelɪtɪvli] - adv	poor compared to some people). относительно A <i>relatively</i> small number of people disagreed.
loss [lɒs] - n	потеря, потери The company made a <i>loss</i> of \$250,000 last year.
lose [luːz] (lost, lost) - v	терять, утрачивать Carol <i>lost</i> interest in ballet in her teens.
vary [ˈveəri] - v	меняться, варьироваться Medical treatment <i>varies</i> greatly from state to state.
various [ˈveərəs] - a	разнообразный, разный We use <i>various</i> methods and devices in our work.
contribute [kənˈtrɪbjʊːt] - v	содействовать, способствовать Alcohol <i>contributes</i> to 100,000 deaths a year in the US.
subject to [səbˈdʒekt] - v	подчинять, -ить; подвергать, -уть 1) The area is <i>subject</i> to drought and floods and earthquakes. 2) He was <i>subject</i> to heart attacks.
rare [reə] - a	редкий, разрежённый A new law to prevent the export of <i>rare</i> birds is to be introduced.
sufficiently [səˈfɪʃəntli] - adv	достаточно The water was <i>sufficient</i> to dissolve the salt.
exceed [ɪkˈsiːd] - v	превышать, превысить Average annual temperatures <i>exceed</i> 20 °C.
excess [ɪkˈses] - n	излишек, избыток This report discouraged us all from eating an <i>excess</i> of fat.
in excess of	свыше
subsurface [sʌbˈsəːfɪs] - a	подводный <i>subsurface</i> deposits of oil
residue [ˈrezɪdjuː] - n	остаток, осадок, мазут Soap can leave a slight <i>residue</i> on your skin.
average [ˈævərɪdʒ] - a	средний, нормальный The age of the candidates ranged from 29 to 49 with an <i>average</i> age of 37.
although [ɔːlˈðəʊ] - j	хотя, если бы даже <i>Although</i> the car's old, it still runs well.
reduce [rɪˈdjuːs] - v	отбензинивать, отгонять лёгкие фракции, диспергировать It was necessary to <i>reduce</i> the reaction temperature from 40° to 30°C to slow down the rate of the reaction.

II. Learn to pronounce the following words of Latin origin and give their Russian equivalents:

natural [ˈnætʃrəl], compose [kəmˈpouz], principally [ˈprɪnsəplɪ], reservoir [ˈrezərwa:], term [tə:m], aquatic [əˈkwætɪk], deficient [dɪˈfɪʃənt], essence [ˈesəns], anaerobic [ˌæniəˈrɒbɪk], bacteria [ˌbækˈtɪriə], material [məˈtɪriəl], methane [ˈmeθeɪn], polycondensation [ˌpɒlɪkəndənˈseɪʃn], organic [ɔːˈɡæni:k], kerogen [ˈki:rədʒən], chemically [ˈkemɪkəli], stable [steɪbl], minor [ˈmaɪnə], bitumen [ˈbɪtjʊmɪn], asphaltenes [ˈæsfælti:nz], original [əˈrɪdʒənəl], conversion [kənˈvɜːʃn], metre [ˈmi:tə], production [prəˈdʌkʃn], dioxide [daɪˈɒksaɪd], water [ˈwɔ:tə], concentration [ˌkɒnsənˈtreɪʃən], preservation [ˌprezəˈveɪʃn], statistical [stəˈtɪstɪkl], scale [skeɪl], microscopic [ˌmʌɪkrəˈskɒpɪk], examination [ɪɡˌzæmɪˈneɪʃn], classify [ˈklæsɪfaɪ], type [taɪp], molecule [ˈmɒlɪkjʊ:l], molecular [mouˈlekjʊlə], aliphatic [æliˈfætɪk], percentage [pəˈsentɪdʒ], structure [ˈstrʌktʃə], aromatic [ˌæro(u)ˈmætɪk], double [dʌbl], elemental [ˌeliˈmentl], contributor [ˌkənˈtrɪbjʊtə], thermal [ˈθə:ml], process [ˈprouses], katagenesis [ˌkætəˈdʒenɪsɪs], temperature [ˈtemprətʃə], gradient [ˈɡreɪdjənt], energy [ˈenədʒɪ], initial [ɪˈnɪʃəl], peak [pi:k], metagenesis [ˌmetəˈdʒenɪsɪs], ratio [ˈreɪʃɪoʊ], contrast [ˈkɒntrɑːst], deposit [dɪˈpɒzɪt], reservoir [ˈrezəˌrwɑ:]

Text I

It is known far and wide that petroleum consists of natural substances, composed mainly of hydrocarbons, found principally in natural underground reservoirs.

The original source material from which petroleum is formed is organic matter *deposited* in sediments, an *aquatic* oxygen-deficient *environment* of deposition being *essential*. The oxygen *deficiency* may occur immediately below the *water-sediment interface*, *rather than* above it. In this environment anaerobic bacteria will convert the material to more stable forms but will not *destroy* it. Large amounts of methane can be produced by these bacteria, but most of it is *unlikely to retain* in the sediment.

Bacterial action in muds *ceases* at *shallow depths*. Below this, polycondensation and *insolubilization* convert organic matter into kerogen, a chemically stable substance consisting mainly of carbon, hydrogen and oxygen. Accompanying the kerogen is *a minor component* of material which can be dissolved in organic solvents. It is called “bitumen” and consists of asphaltenes, *resins* and also hydrocarbons *derived* from the organic matter.

Conversion of organic matter to kerogen is assumed to be largely *completed* at depths of about 30 metres (100 feet) to 100 metres (3,500 feet), the only major change being a *relatively high loss* of oxygen due to the production of carbon dioxide and water.

The concentration of kerogen in *sedimentary rocks* *varies* widely depending on the amount of source material, its preservation and the rapidity of sedimentation. Thus, the statistical concentration of organic matter *on a world wide scale* is about 1.0% organic carbon.

Based on microscopic examination and chemical analyses, kerogen has been classified into three types. Types I and II have molecules containing a high percentage of saturated carbon structures (single bonds), while Type III has a high percentage of aromatic carbon structures (double carbon bonds). Types I and II are rich in hydrogen (elemental hydrogen-carbon ratio respectively 1.3 and 1.4), while Type III is hydrogen poor (elemental hydrogen-carbon ratios between 0.1 to 0.4).

It should also be noted that pure Type I kerogen is relatively *rare* and occurs most often in environments where plankton *algae* are the main *contributors* of organic matter.

When kerogen *is subjected* to a sufficiently high temperature resulting from *deep burials*, it breaks down by thermal cracking into simpler molecules with the generation of hydrocarbons. This petroleum producing process is known as katagenesis. It is assumed to begin at *subsurface* temperatures between 50⁰ and 75⁰C (120⁰ – 170⁰F) and at *average* depth of 1 kilometre (3,500 feet), *although* the depth can vary greatly depending on the temperature gradient.

As the burial depth decreases, the increasing energy level resulting from the increasing temperature thermally cracks the kerogens with increasing production of simpler and lighter petroleum molecules. Three stages of katagenesis are recognized: 1) initial oil generation, 2) peak oil generation and 3) wet gas stage.

The final stage of evolution where the kerogen is reduced to a carbonized residue and petroleum conversion into methane is known as metagenesis. It usually occurs at depth of over 3,500 metres (11,500 feet) and at subsurface temperatures in *excess* of 175⁰C (350⁰F).

The quantity of petroleum (oil plus gas) produced is dependent on the hydrogen content of the kerogen expressed as the elemental hydrogen – carbon ratio.

Hydrogen generation occurs mainly in the wet gas stage of katagenesis and in the metagenesis stage, the petroleum products being wet and/or dry gas.

Notes:

1. it is known far and wide – во всём мире/повсюду/ известно
2. original source material – исходное материнское вещество
3. an aquatic environment – водная среда
4. rather than – более вероятно; чем, а не
5. shallow depth – небольшая глубина
6. insolubilization – перевод в нерастворимую форму
7. resins - смолы
8. minor component – очень небольшое количество компонента
9. sedimentary rocks – осадочные породы
10. on a world wide scale – в мировом масштабе
11. alga ['ælgə] – algae ['ældʒi:] – морские водоросли
12. deep burials – глубокие погружения
13. are recognized – распознаются, различаются
14. wet gas – жирный газ
15. are reduced to carbonized residue – отгоняются лёгкие фракции до карбонизированного остатка
16. (are) well above – намного/гораздо выше
17. dry gas – нефтяной газ

I. Find English equivalents in the text:

повсюду; главным образом; естественные подземные резервуары; исходное материнское вещество; отложенного в осадках; водная бескислородная среда отложения; граница раздела вода-осадок; а не /скорее, чем/; переход в нерастворимое состояние; смолы; образовавшиеся из; в основном; на глубинах; сохранность; большой процент потери кислорода; осадочные породы; скорость осадконакопления; статистические данные о концентрации; во всём мире; исследование; предельные углеводородные структуры; с одной связью; соотношение элементов; бедный водородом; встречаться в основном в; основная составляющая часть органического вещества; подвергаться довольно высоким температурам; глубокое погружение; разлагаться на; образование углеводородов; процесс нефтеобразования; возросшие температуры; дегидрогенезация кирогена; по весу; стадия начального образования нефти; максимальное нефтеобразование; на стадии жирного газа.

II. Learn to identify nouns by the following suffixes. Guess their meanings:

ity - probability, rapidity, activity, salinity, convertibility, possibility, reactivity, necessity, solubility, insolubility, stability, changeability, productivity, quality, ability, capability, capacity, selectivity.

ment - development, achievement, establishment, statement, sediment, environment, refinement, treatment, measurement, arrangement, placement.

III. Match A and B. Choose from list B synonyms to the words of list A:

A	B
1. essential	a. transform
2. far and wide	b. initial
3. principally	c. demand/need
4. original	d. originate
5. deposition	e. important
6. deficiency	f. sediment
7. occur	g. all over the world/everywhere/throughout
8. convert	h. mainly
9. derive (from)	i. comparatively
10. destroy	j. nearly
11. cease	k. stop
12. assume	l. mean
13. contain	m. rather
14. relatively	n. take place
15. over	o. decay/decompose
16. about	p. believe
17. average	q. crack
18. preserve	r. retain
19. require	s. include/be composed of
20. break down	t. above/in excess of
21. deficit	u. shortage/lack of

IV. Choose antonyms from list B to the words of list A:

A	B
1. deficiency	a. unstable
2. initial	b. complex
3. convert	c. increase
4. likely	d. major
5. lose	e. dry
6. stable	f. unsaturated
7. finish	g. begin
8. saturated	h. about
9. rich	i. inorganic
10. high	j. poor
11. decrease	k. heavy
12. simple	l. unlikely
13. light	m. low
14. over	n. excess
15. wet	o. final
16. minor	p. retain
17. natural	q. artificial
18. organic	r. conserve

V. Make up English-Russian pairs of the adverbs equivalent in meaning:

A

1. far and wide
2. principally
3. rather than
4. accurately
5. relatively
6. respectively
7. sufficiently
8. widely
9. mostly
10. thus
11. thermally
12. in excess
13. properly
14. well above

B

- a. в большинстве случаев
- b. главным образом
- c. повсюду
- d. тщательно
- e. а не/скорее чем
- f. относительно
- g. в избытке
- h. правильно/должным образом
- i. термически
- j. таким образом
- k. широко
- l. намного выше
- m. соответственно
- n. значительно

VI. Match A and B:

A	B
1. deposit	a) a lack of something that is necessary; shortage
2. retain	b) the air, water and land on Earth which can be harmed by man's activities
3. cease	c) extremely important and necessary
4. residue	d) to damage something so badly that it no longer exists or cannot be used or repaired
5. genesis	e) measuring only a short distance from the top to the bottom
6. environment	f) to get a chemical substance from another substance
7. exhaustion	g) not seen or found very often, or not happening very often
8. reduce	h) an amount of a substance that has been left somewhere as result of a chemical and geological process
9. essential	i) when all of something has been used
10. destroy	j) enough/adequate
11. shallow	k) to keep something or continue to have something
12. sufficient	l) some amount of a substance that remains in a container after a chemical process
13. derive	m) to make it smaller in size or amount or less in degree
14. rare	n) to stop doing something or stop happening
15. deficiency	o) the beginning or origin of something

VII. Translate the following sentences into Russian. Pay attention to the place and the translation of Participle I in a certain position.

Example: A. Speaking of oil one should remember ...

Говоря о нефти, нужно помнить ...

B. Hydrolysis reactions producing fatty acids ...

Реакции гидролиза, образующие жирные кислоты ...

C. Having estimated the amount of carbon ...

Рассчитав количество углерода, ...

1. Discussing the concept of oil origin one should remember that it has taken organic matter many years to have converted into crude oil.
2. Decaying organic matter falling to the sea bottom gradually accumulated, thus forming thick layers of ancient seas.
3. Hydrolysis reactions yielding fatty acids, glycerin and other products may take place in the thick layers formed.
4. Having dissolved in fatty acids all these hydrocarbons yield homogeneous tar-like mass.
5. Kerogen is a chemically stable substance consisting mainly of carbon, hydrogen and oxygen.
6. A minor component accompanying the kerogen can be dissolved in organic solvents.
7. Type I and II are found to have molecules containing a high percentage of saturated carbon structures. While kerogens having a high percentage of aromatic carbon structures are classified to Type III.
8. The increasing energy level resulting from the increased temperature thermally cracks the kerogens, thus increasing the amount of simpler and lighter petroleum molecules.
9. Type III kerogen having mainly polyaromatic molecular structures and few aliphatic chains requires more energy for breaking down the kerogen molecules.
10. A gas consisting of one carbon atom and four hydrogen atoms is termed as methane.
11. A hydrogen atom having only one bond can never unite with more than one other.
12. Normally the atom has equal amounts of positive and negative charges, making it neutral.
13. The lighter, negatively charged particles in the atom are electrons moving in orbits around its nucleus.
14. The text includes fragments of the opinions concerning the subject under discussion.
15. Introducing other elements into original material quite new ones are obtained.

VIII. Translate into Russian the following sentences using adverbial participial constructions (when as, if, while + ing):

Example: 1. While making his experiment he obtained ...

а) проводя эксперимент, он получил ...

б) при проведении эксперимента, он получил ...

в) когда он проводил эксперимент, он получил ...

2. Having made his experiment he obtained ...

проведя эксперимент, он получил ...

3. Having been obtained the new substance can be used as ...

после того, как получили новое вещество, оно может быть использовано как ...

1. While preparing the chemical in question, we had to apply high temperatures and pressures.
2. Having separated the mixture into its components, the chemist subjected them to elementary analysis.
3. When dealing with silicon, its weak affinity for hydrogen compared with that of carbon should be taken into consideration.

4. Any element when combining with another one gives a new one.
5. Having been compressed the air is to be cooled.
6. Having been composed of liquid particles emulsion dispersed other liquids.
7. Having completed the experiment the chemist could describe the properties of the product obtained.
8. Having been given all the instructions we could effect the process concerned properly.
9. Having been separated from the liquid mixture, the components were to be carefully examined.
10. When heating this substance, one should be very careful.
11. Having investigated all the properties of this unusual water the scientists could solve the mystery of silvery clouds.
12. When comparing these substances, one can see that they are very much alike.

IX. Translate the following sentences with Participle II. Pay attention to the translation of Participle II with “when”, “if”, “once” and in the attributive function.

Example: a) When heated, the body expands.

при нагревании тело расширяется

(когда тело нагревается, оно расширяется)

b) The body heated to 500⁰C, changes ...

тело, нагретое до 500⁰C, изменяет ...

1. If properly processed, these raw materials can provide us with all necessary substances.
2. Once started the process is difficult to stop.
3. All materials normally expand when heated and contract when cooled.
4. What is so unusual about the environmental problem when compared to the other ones?
5. When expressed in a popular form, all definitions are simplified and thus inaccurate.
6. When subjected to wet air, copper becomes coated with a green basic oxide.
7. By application of the above mentioned processes to crude oil and its fractions a limited number of refined oil products are produced.
8. The activated clay used in the above described process cannot be regenerated.
9. The resulting ethylene oxide is absorbed in water, recovered by steam distillation and finally fractionated to give the purity required.
10. Natural gas is also found associated with crude oil as a gas cap above the oil or unassociated with it.
11. When burnt, diesel fuels produce corrosive gases.
12. The undesired aromatic hydrocarbons can be recovered unchanged and the refining agent can be recovered and used again.
13. The processing was expensive and the disposal of the spent acid and the constituents so removed presented a difficult problem.
14. It is sometimes said that there is no such thing as the so-called “scientific method”: there are only the methods used in science.
15. The hypothesis concerned synthesized materials and did not apply to natural products.
16. The technique applied provided the required mechanism of reaction.

X. Remember that the English words “concerned”, “considered”, “in question”, “under consideration” are all translated into Russian as “рассматриваемый, обсуждаемый, данный”. Render into English the following sentences:

1. Рассматриваемая концепция, по-видимому, не будет принята всеми. (to recognize)
2. Рассматриваемые реакции будут протекать только в присутствии катализатора. (to proceed)

3. Данные температуры не могут быть получены при обычных условиях. (under normal conditions)
4. Обсуждаемое изобретение появилось в тот момент, когда люди нуждались в нём.
5. При каких условиях данная реакция будет протекать довольно быстро без выделения огромного количества тепла?
6. Кажется, его интересует обсуждаемая проблема.
7. Оказывается, что он тоже работает над данной проблемой.
8. Правильность обсуждаемой теории была доказана многочисленными экспериментами.
9. Точность обсуждаемых результатов зависит от чистоты проверяемых экспериментов. (the accuracy of)
10. Обсуждаемая проблема потребовала дальнейшего исследования.
11. Данный вопрос оказался очень сложным.
12. Довольно трудно обнаружить все дефекты рассматриваемого прибора. (to see the defects)

XI. Translate the following sentences with Participle I and II. Mind their position in the sentence.

1. The basic reactions taking place are similar to those when using the sulphuric acid catalyst.
2. The carbonaceous material formed during cracking usually called as “coke” is deposited on the catalyst surface, thus reducing its activity.
3. Using a formula for sulphur oxide emissions, the group calculated the estimated total amounts of mercury released from the plants.
4. Many of the silicate minerals once melted do not crystallize readily when cooled but form noncrystalline glasses.
5. Having cooled the concentrated solution of naphthalene in hexane we obtained white deposit of pure naphthalene.
6. Having been passed through a hot tube arsenite deposited arsenic in the form of metallic film.
7. Solutions containing much of the solute and little of the solvent are called strong concentrated solutions.
8. Any element when combining with oxygen forms an oxide.
9. Having been cooled to a very low temperature many substances acquire quite new properties.
10. When heated, concentrated sulphuric acid reacts with metals.
11. When freshly prepared this substance is colourless.
12. Having obtained the necessary fraction we could finish our experiment.
13. When exposed to air at room temperature phosphorous begins to oxidize.
14. Oxygen and hydrogen can be obtained when decomposing water by electrolysis.
15. Having identified the various components of an unknown substance an analyst is able to isolate each and determine its properties.
16. Finely divided calcium oxidized rapidly when exposed to the air.

arsenite – арсений, соль мышьяковой кислоты

arsenic – мышьяк

XII. Grammar Revision. Translate into Russian the following sentences with the Complex Subject:

1. Petroleum is known to consist of natural substances composed of hydrocarbon.
2. The original source material from which petroleum is formed was found to have deposited in an aquatic oxygen-deficient sediments.
3. Anaerobic bacteria are believed to have converted that organic matter to more stable forms.
4. Large amounts of methane produced by these bacteria are unlikely to have retained in the sediment.

5. Bacterial action in muds appears to cease at shallow depth.
6. Kerogen has turned out to be a chemically stable substance consisting mainly of hydrogen, carbon and oxygen.
7. Conversion of organic matter to kerogen is assumed to be largely completed at depths of about 30-100 metres.
8. It is believed that most of the problems which we are concerned with at present are likely to be solved by the year 2010, then it is necessary to consider what problems can be expected to remain unsolved. These subjects seem to be of a rather general nature which appear to fall into these classes: the origin of life on Earth; the existence of life on other worlds and the communication with other living beings if they are assumed to exist. Finally, one must consider the problems of such a long-term /долгосрочный/ character that can not be expected to be solved by the year 2012.

XIII. Translate into Russian the following sentences. Remember that the word “matter” may be used as a noun /материал, вещество; дело, вопрос; сущность/ and as a verb иметь значение; no matter how – “как бы ни”.

1. The statistical concentration of organic matter all over the world is about 1.0% organic carbon.
2. The development of new techniques is a matter of major concern for many countries.
3. Chemistry deals with changes in the composition of matter.
4. It is no easy matter to describe this phenomenon in detail.
5. The answer to this question, however, will hardly matter under present conditions.
6. The matter is far more complex than that the laboratory equipment becomes obsolete very soon.
7. It doesn't matter what type of petroleum we shall consider, it is mainly composed of hydrogen and carbon.
8. No matter how costly the process may be, it will be used commercially.
9. A nuclear catastrophe will involve every country, no matter how small or big it is and will concern every individual.
10. No matter how complex the problem may be, it is sure to be solved.

XIV. Translate the following sentences with the word “concern”. Define its function.

1. The text includes fragments of the opinions concerning the subject under discussion.
2. The science of crystallography concerns with the classification of all possible types of crystal structure.
3. The chemist's basic concern is dealt with structure of molecules and reactions in which these structures change.
4. The discussion concerns problems of common interest for most scientists.
5. The problem under discussion “Man and his Environment” concerns everyone.
6. Our institute is also concerned with the project in question.
7. Chemistry is concerned primarily with the structure of atoms and the nature of the substances which these particles compose.
8. It is necessary to inform all those concerned with the problem.
9. The number of theories advanced is increasing but many papers dealing with the problem have to admit that there is a lot of other opinions concerning the result obtained.

XV. Translate into Russian the following sentences with the verb “to result in” (приводить к ч-л, давать ч-л), “to result from” (появиться в результате ч-л, возникнуть).

1. The principal operating problems are known to result from hydrogen sulfide corrosion.
2. Organic matter deposited in an aquatic oxygen deficient environment has resulted in petroleum formation.

3. Stabilization of petroleum produce results from converting reactive materials, especially diolefines, to less reactive ones.
4. The hydrogenation of olefins resulting in the production of corresponding alcohols is a well known fact.
5. Raising the temperature of propane results in the reduction of its dissolving capacity and improving its selectivity.
6. His research resulted in establishing a new mechanism of the process.
7. Cooling at a controlled rate with continuous mixing results in the formation of grease structure.

XVI. Mind the position of the word “rather” in a sentence:

rather + adjective – довольно; “rather than” – а, не; скорее чем;

“rather” at the beginning of a sentence – скорее, вернее.

1. These dying organisms have formed soft rather thick layers of organic matter.
2. Some people say that chemistry rather than physics is likely to dominate.
3. This point of view is rather common.
4. Oil industry has changed in the last 60 years from a rather crude art to a great scientific industry.
5. Rubidium is not found in any mineral as the main constituent, rather, rubidium occurs widely dispersed in potassium minerals in very low concentration.
6. Rather, we are concerned with the general structure of the kinetic theory for dense polyatomic media (среды).
7. Not a single property, but rather a combination of properties has made this substance outstanding.
8. This technique was borrowed from chemistry which is rather typical of the present-day biology.
9. Sometimes one has to end the colloid stability rather than maintain it.
10. Oil and grease do not mix with water but rather float on the surface.

rubidium – рубидий

XVII. Read Text II, divide it into paragraphs and give a heading to it.

Text II

Petroleum is known to be a mineral but its origin is thought to have been animal and vegetable. It should be noted that in addition to mineral petroleum we have animal oils such as those provided by some land animals and certain types of fish. We also have vegetable oils, such as those produced from olives, cotton seeds and nuts of various kinds. Here, however, we are only concerned with a mineral oil and its influence on mankind and the situation in the world. The age of petroleum can be determined rather accurately from the age of the rocks in which it is found. Thus, it has been established that some petroleum is half million years of age. Moreover, scientific methods have made it possible to determine the limits of most of the world's oil fields. Here the question arises, “How long will oil last?” The answer to this question depends on how much oil the world wants, how much the industry can produce on continued discovery of new oil fields and the supplies of other sources of energy. It is also computed that about half of the world's power requirements are met by petroleum industry, the consumption being some 600 million gallons every day, the world oil reserve being 190,000 million barrels. (One barrel is 35 gallons and there are 7.4 barrels in one metric ton). The demand for petroleum has risen drastically and the search for oil goes all over the world. On the whole, there are now more than half a million of wells in the world, producing more than 1,000 million tons of petroleum a year.

Notes: nut – орех
seeds – семена

1. What facts have you found most striking?
2. Have you known all those figures before?
3. What other facts do you know about petroleum? Tell your fellow-students about them.

XVIII. Make sure that you do know the material of Lesson II.

Translate into Russian the following sentences without using a dictionary.

1. Превращение органического вещества в кероген, как считают, в основном происходит на глубинах от 30 до 100 метров.
2. Кероген – это химически стабильное вещество, состоящее в основном из углерода.
3. Кероген, как известно, теряет довольно большое количество (процент) кислорода вследствие образования углерода и воды.
4. Концентрация керогена в материнском веществе может быть различна, и зависит она от многих факторов.
5. Кероген классифицируется на три типа.
6. Молекулы керогена типа I и II содержат большой процент насыщенных углеводородных структур, имеющих одинарные связи, в то время как тип III содержит высокий процент ароматических структур с двойной связью.
7. Если тип I и II – богаты углеродом, то тип III – беден им.
8. Следует сказать, что тип I керогена – довольно редок в природе.
9. Кероген разрушается на более простые молекулы с образованием углеводородов под действием довольно высоких температур и на большой глубине.
10. Этот процесс нефтеобразования известен как катагенез.
11. Различается три стадии катагенеза: стадия начального нефтеобразования, максимального и стадия жирного газа.
12. Завершающей стадией эволюции нефти является метагенез, когда из керогена отгоняются лёгкие компоненты нефти до карбонизированного остатка.

XIX. Learn the dialogue:

DIALOGUE

- I hear, you are a process engineer, an expert in oil and gas refining, aren't you? I don't think you mind my asking you some questions on petroleum producing processes? The matter is that while reading special American literature on it, I've come across some terms which are quite unfamiliar to me.
- Oh, which ones?
- These are kerogens, katagenesis and metagenesis, if I'm not mistaken.
- I see, all these terms certainly exist and they only refer to petroleum and gas generation processes. Let's begin with kerogens.
- All right, I'm all ears.
- You see, kerogens resulted from the conversion of organic matter through polycondensation and insolubilization are, in fact, a chemically stable substance consisting mainly of carbon, hydrogen and oxygen. Thus, kerogens are the basic constituent of petroleum. Besides that, there is a small amount of bitumen easily dissolving in organic solvents.
- Why, is it the bitumen used for road building? But why do we usually speak of petroleum as a mixture of hydrocarbons, but not of kerogens?
- Just a moment, I'm coming to the point. Kerogens subjected to sufficiently high temperature, the so-called thermal cracking, break down into simpler molecules with the generation of hydrocarbons. So, this petroleum producing process is known as katagenesis.
- Oh, it's really very interesting. Do you happen to know under what conditions this process takes place?

- As I've already said, the conditions are those of thermal cracking, that is, the temperature is in excess of 175⁰C and the burial depth of over 3,500 meters. As you can see, it means high pressures. Is everything clear to you now?
- Oh, of course, it is. What about metagenesis?
- As far as metagenesis is concerned, it is the final stage of hydrocarbon evolution, where kerogen is reduced to a carbonized residue and the petroleum converts into methane.
- So metagenesis is the gas producing process, isn't it?
- That's it.
- Thank you very much.
- Glad to be of any use to you.

XX.

1. Refer to Text I, identify key sentences in each paragraph and write them down.
2. Make a summary of the text using your key sentences, read your summary to the class.

XXI. Having done all the above exercises speak on the following subjects:

1. Kerogens:
 - a) what they are,
 - b) their role in the petroleum producing process.
2. Katagenesis.
3. Metagenesis.

XXII. Render the following text into English, using active vocabulary of Lesson II (Text I p 10).

Формирование материнской породы

Нефть и газ образуются из органической материи, содержащейся в некоторых типах осадочных отложений, в результате её постепенного преобразования. Осадки, принесенные течением водных потоков, откладываются на дне морей, где имеет место более или менее активная животная и растительная жизнь, порождающая большие объёмы органического вещества.

Морская биомасса представляет собой совокупность живых организмов различной величины. Однако они составляют лишь небольшую часть от совокупного объёма животной биомассы моря. Её основу составляют мелкие ракообразные, а также организмы, различимые только под микроскопом: зоопланктон.

Тоже можно сказать и о растительной биомассе морей. Все эти большие и маленькие представители морской фауны и флоры имеют свой жизненный цикл и, рано или поздно умирают, а их останки, оседая на дне океанов и морей, смешиваются с осадочными отложениями. Большая часть этой органической массы исчезает, разлагаясь (путём медленного или быстрого окисления) под действием бактерий. Однако часть все же остается, особенно если отложение биомассы происходит в среде, бедной кислородом и бактериями. В этом случае образуются отложения, богатые органической материей. Эти отложения, как правило, являются глинами. Они образуют материнскую породу нефти и газа. Подвергаясь воздействию давления и температуры, органическая материя преобразуется в кероген – предок нефти и газа. В некоторых породах (например, в битуминозных сланцах) кероген встречается в непретворенном виде. Однако обычно в богатых керогеном породах под воздействием давления и температуры кероген постепенно преобразуется в нефть и газ. Иногда этот процесс называют «углеводородной кухней».